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The role of Alfven wave for spicule formation, coronal heating, and solar wind acceleration

Takuma Matsumoto[1*]

[1]Nagoya University

We performed MHD simulations for nonlinear Alfven wave propagation in the solar flux tube. Mode conversion of Alfven waves are known to be one of the mechanisms to explain spicules, jet like phenomena in the solar chromosphere. Moreover nonlinear dissipation of Alfven waves has possibility to explain the coronal heating and the solar wind acceleration simultaneously. However, whether the above models succeed or not highly depends on the power spectrum of Alfven waves driven at the photosphere. In this talk, we examined the existing models by using the observed power spectrum of photospheric velocity newly derived from Hinode G-band movies.

To begin with, we performed 1D MHD simulation for nonlinear Alfven wave propagation along a flux tube. We derived the horizontal velocity spectra at the photosphere using G-band movies observed with Hinode/SOT. The observed power spectra are used to drive Alfven waves in our simulations. Using the observed power spectra, we can reasonably explain spicule motion and energy flux necessary to heat the corona. We also found that the region between the photosphere and the transition region becomes Alfven wave resonant cavity, which works efficiently to heat the corona. Then, we applied almost the same model to the solar wind acceleration by extending our numerical domain. The Alfven wave theory is confirmed to maintain the corona and drive the solar wind with Alfven wave generation by the observed power spectra. Finally, we tested the validity of 1D approximation by performing 2D MHD simulation for Alfven wave propagation in the solar flux sheet.

Keywords: Alfven wave, MHD, spicule formation, coronal heating, solar wind acceleration